

# An Investigation on the Teaching Mode of “Root of Problem Thinking” Based on the Concept of OBE

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**Abstract:** In pedagogy, the “Root of problem” is often used to express the core elements and basic theories of knowledge. In this paper, we design a teaching model based on root problem thinking under the guidance of OBE concept. The model leads students to condense the root problem by creating problematic scenarios and guiding them in the process of outcome-oriented heuristic teaching. Through the extension and expansion of core knowledge, the process of deepening knowledge from point to surface is realized. The teaching model can help students form excellent qualities of thinking in the process of analysis and synthesis, abstraction and generalization, systematization and concretization of thinking training. In order to further prove the effect of the new teaching mode, we implemented the teaching reform work for the teaching process of the Python Programming course of the Internet of Things Engineering major in the College of Computer Science, and achieved good teaching results.

**Keywords:** Root of problem; OBE; heuristic teaching; teaching reform

## 1. Introduction

With the society's constantly increasing demand for knowledge-based and skill-based talents, the desire to cultivate talents with good learning, who can discover the focus of affairs and have a sense of innovation has become imminent, This demand promoted the continuous change of the education system in universities, as well as the continuous innovation of instructional methods and teaching concepts.<sup>[1]</sup> Specifically, in the implementation of today's teaching process, the transfer of knowledge is no longer a tracing full coverage, exhaustive, but focus on leading students to be good at identifying problems, condensing problems, problem-solving ability, to achieve the “teaching a man to fish is not as good as teaching a man to fish”.

The OBE concept is an emerging educational concept that takes learning outcomes as the starting point and designs the teaching process in reverse, which advocates students' “independent learning, cooperative learning and inquiry learning”.<sup>[2]</sup> The integration of “Root Problem Thinking” in the outcome-oriented curriculum education model allows students to condense the essence of the problem in the application scenario tasks predefined by the teacher. By analyzing and summarizing the appropriate methods to overcome the problems, students can master the theoretical knowledge taught in the classroom and improve their problem-solving ability.

## 2. Related studies

There has been a long history of research around the application of the OBE concept in teaching and learning, the major elements of which cover a rich range of perspectives and research content.<sup>[3-6]</sup>

The OBE is defined by Spady W.D.<sup>[7]</sup> in “Output-Based Education Models: Controversies and Answers” as the goal-oriented focusing and organizing of the educational system so as to ensure that students are able to carry out their learning activities around the goals of their training, so that they graduate with substantial learning outcomes. Willis S et al.<sup>[8]</sup> interpret the OBE philosophy of

education as a teaching and learning process which aims to help students achieve predetermined learning outcomes through their studies. In addition to the research work on the concept of OBE, some scholars have also carried out a great deal of work on the study of root problem thinking. This includes Guo Xiaoying's [9] proposal of gradually centering on core concepts (Root of Problem) in instructional design, actively playing the role of core concepts, and focusing on the connection between knowledge, so as to promote students' understanding and mastery of knowledge, and ultimately achieve the goal of quality education. Hu et al. [10] introduced the operation method of unit teaching under the leadership of core concepts. Factual teaching centers around the Root of Problem, guides questions to stimulate students' thinking, and allows students to construct the Root of Problem by themselves through activities.

Therefore, the implementation of the “Root of Problem Thinking” teaching mode based on the concept of OBE will provide a solid support for the development of teaching, evaluation of teaching effect, formulation of talent cultivation program and the construction of teaching team.

### 3. Architecture of Root Problem Thinking Teaching Model Based on OBE Concepts

A new model of outcome-oriented education that incorporates “root problem thinking” is the main entry point for this research. The main elements of the study are shown in Figure 1.

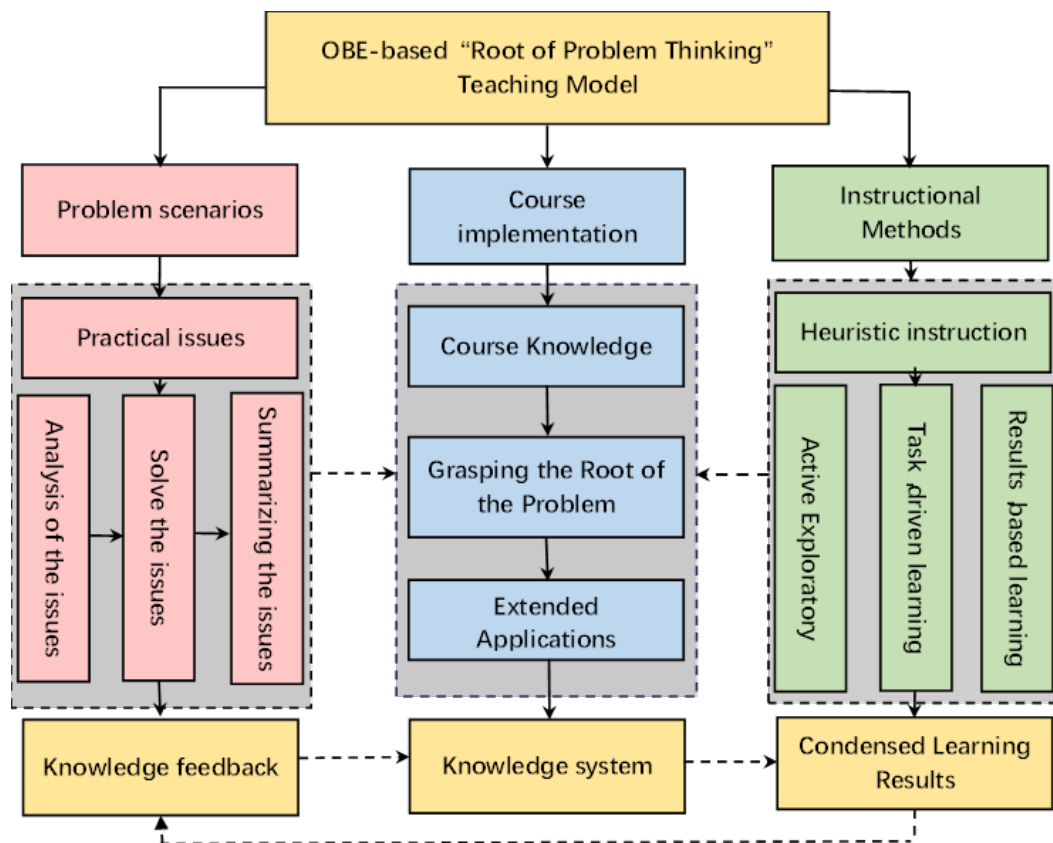


Fig. 1 Main research components

#### 3.1 Research on the implementation process of the data-driven “Root Problem Thinking” teaching process

In the process of teaching and implementation, we respond to the learning needs of the OBE concept, clarify the objectives of the curriculum, take the “root question” as the core content, and establish the source of knowledge. We utilize big data technology to process and analyze all kinds of data generated in the teaching process, so as to realize the evaluation of teaching effects and optimization of the teaching process.

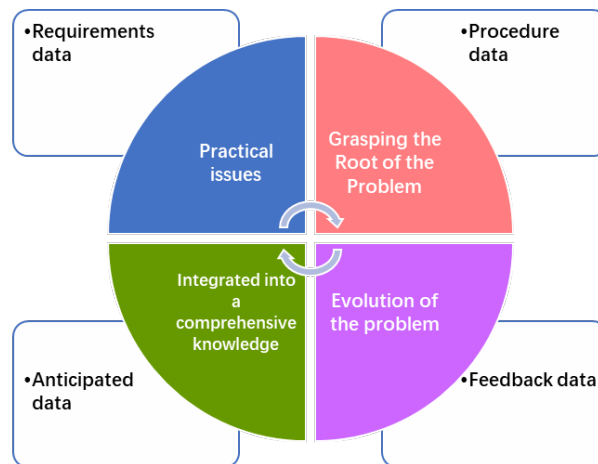


Figure 2 Data-driven implementation of “Root Problem Thinking” education

As shown in Figure 2, in the practical issues stage, teachers set up typical problems in advance in a result-oriented manner, collect students' requests from their analysis, problem solving and summarization processes, and construct demand data. In the stage of condensing the root problem, the demand data are summarized to form the root problem, and the process data are constructed. In the problem evolution stage, the condensed root problem is analyzed for evolution, the application scenarios of the problem are promoted, and the feedback data are formed. Finally, in the integration stage, the data generated in the teaching process is analyzed using big data technology, and the results are fed back to the first stage to promote the reform of teaching.

### 3.2 Research on the construction of outcome-oriented independent learning scenarios

The construction of the learning scenario is shown in Fig. 3, which requires students to carry out independent learning from discovering the problem, solving the problem, and summarizing the problem in an authentic preset situation. Instructors build real application scenarios to form practical problems derived from classroom theoretical knowledge, so that students can apply the corresponding thinking methods to the problem to carry out the research, abstract concepts, and be able to migrate and apply the knowledge gained to new work scenarios, which ultimately lead to the mastery of the knowledge.

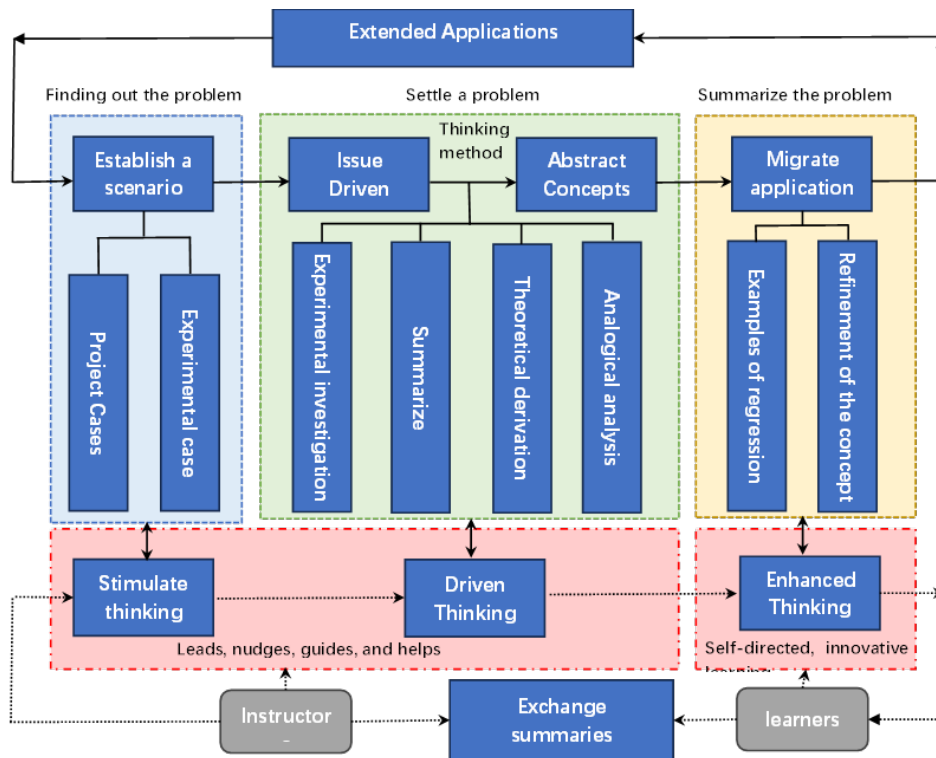


Figure 3 Outcome-oriented self-directed learning scenario

### 3.3 Research on Improving Teaching Methods and Encouraging Changes in Teaching Styles

Innovations in educational technology will enhance the efficiency of teaching and learning and help the learning process to move towards personalization, comprehensiveness and innovation. In terms of teaching methods, we abandon the traditional “duck-filling” teaching methods in the course of lectures and aim at mobilizing students' learning enthusiasm. We try to focus on heuristic teaching methods, highlight the concept of OBE, and instruct students to focus on results-oriented, task-driven active inquiry-based learning to enhance the initiative and innovation of learning.

### 3.4 Study on Promoting Innovation in Teaching Management and Evaluation Methods

The development of emerging information technology promotes the continuous development of all aspects of teaching in the direction of automation, intelligence and scientization, especially in teaching management and evaluation. The input of new technologies has made it possible to focus the large amount of data generated in the teaching and learning process, effectively promoting a more scientific and rational teaching management and evaluation process.

## 4. Instructional design of Roots Thinking based on OBE concepts

The “Root Problem Thinking” teaching model based on the OBE concept is based on a comprehensive analysis of learners' individual characteristics and learning conditions. The cognitive status of learners can be customized, so that each learner has the possibility to discover problems, analyze them and solve them in their own preferred scenarios, thereby recognizing the origin of the problems. The implementation of this teaching model requires the following.

We combine the knowledge mapping technology to condense the root question thinking and carry out the analysis of independent learning behavior of OBE concept, which includes the process of data collection, AI modeling, and data training in the learning process. To provide a reference basis for the development of educational decision-making.

We develop a scientific and reasonable cultivation model that adapts to application-oriented

talents. We personalize the knowledge push according to the needs of learners to achieve more efficient and accurate learning, and develop an open syllabus to meet educational needs.

We are scientifically planning the teaching content, and fully utilizing constructivist teaching theories to prepare detailed lesson plans based on students' individual characteristics.

We create targeted teaching PPT which are lively and full of information based on the syllabus and the structure of the teaching materials.

## 5. Evaluation of the effectiveness of teaching

In order to further prove the effect of the new teaching mode, we implemented the teaching reform work for the course of Python Programming in the course of Internet of Things Engineering in the College of Computer Science in the academic year of 2024. In the final assessment process, we quantified the students' grades into five grades: A [90, 100], B [80, 90), C [70, 80), D [60, 70), E [0, 60). After one year of instructional implementation, the distribution of students in each grade showed a large change, as shown in Table 1.

*Table 1 Comparison of Python Programming Course Grade Distribution for IoT Engineering Majors*

level	Academic year 2023		Academic year 2024	
	No. of students	proportion (%)	No. of students	proportion (%)
A level	2	2.99	18	32.14
B level	5	7.46	19	33.93
C level	16	23.88	12	21.43
D level	32	47.76	6	10.71
E level	12	17.91	1	1.79

From the data in Table 1, it can be seen that most of the students' grades are concentrated in the C and D grades when the "Rooted Problem Thinking" teaching mode based on the OBE concept has not been implemented. At the same time, it can also be seen that the number of failing students is more distributed. In order to improve student achievement as a whole, the implementation of the new instructional model in the academic year 2024 resulted in significant improvements in instructional outcomes. As can be seen from Table 1, the percentage of students in Level D decreased significantly during the academic year, with an overall percentage decrease of 37.05%, while the percentage of students in Level A and Level B increased by 29.15% and 26.33%, respectively. Therefore, it can be seen that the new teaching mode can effectively stimulate students' interest in learning and fully mobilize students' subjective initiative, which can enhance teaching performance.

## Conclusion

With the introduction of the "Root Problem Thinking" teaching model based on the concept of OBE, the demand of teachers and students for high-quality learning resources and intelligent learning environments has provided new possibilities. This model has had a significant impact on teaching and learning, improving the attention to detail not traditionally available in experience-based education. It provides new ways of personalizing teaching and learning and promotes a shift in mindset to actively support pedagogical changes that incorporate "Root Problem Thinking" in outcome-oriented curricular education models.

## Fund Project

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